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The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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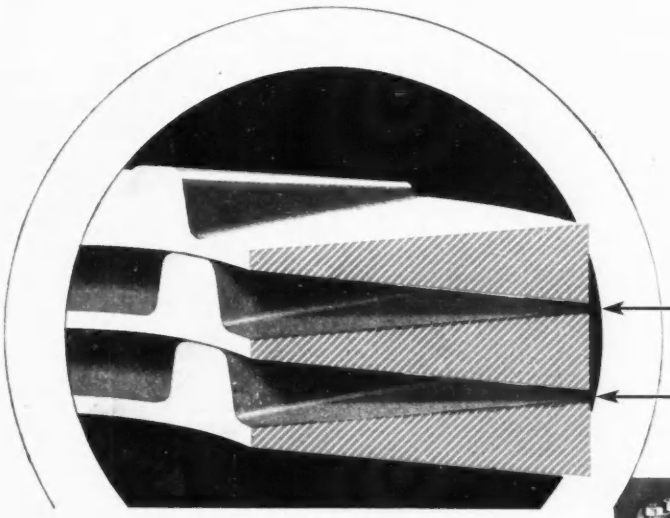

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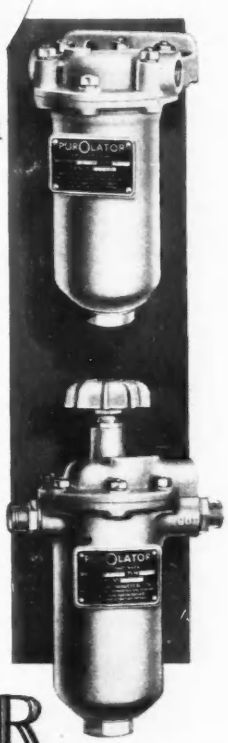

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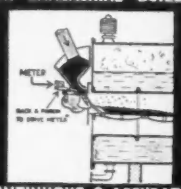

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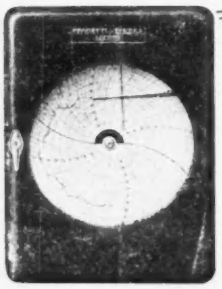

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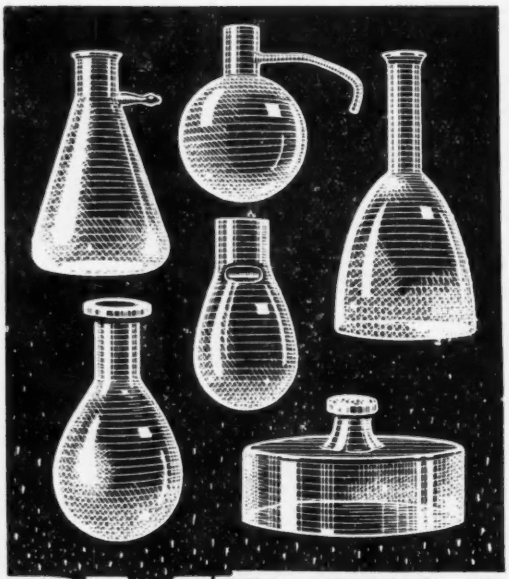

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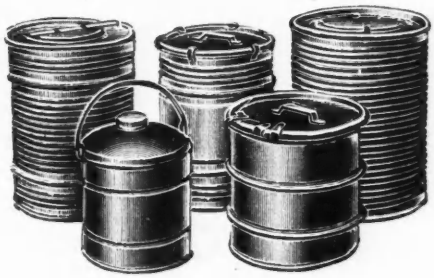

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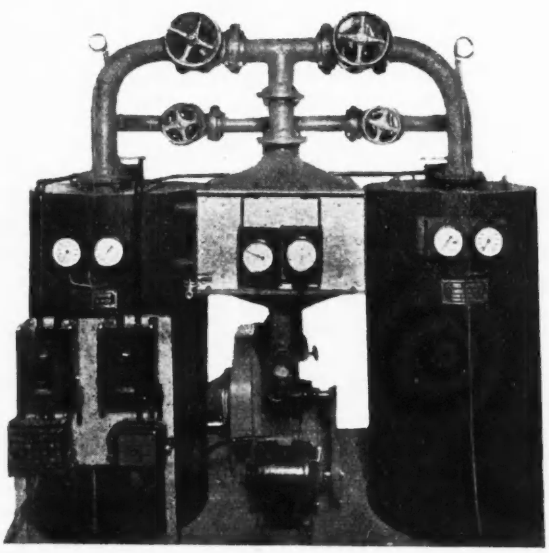

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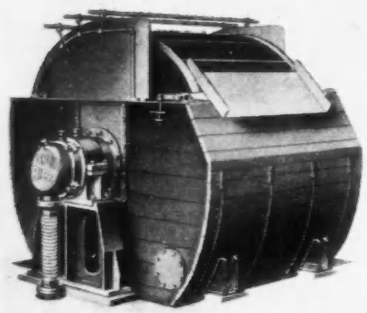

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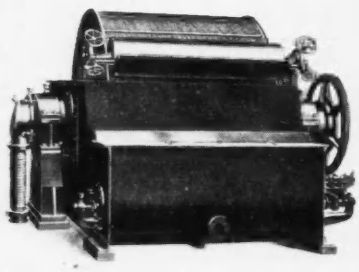

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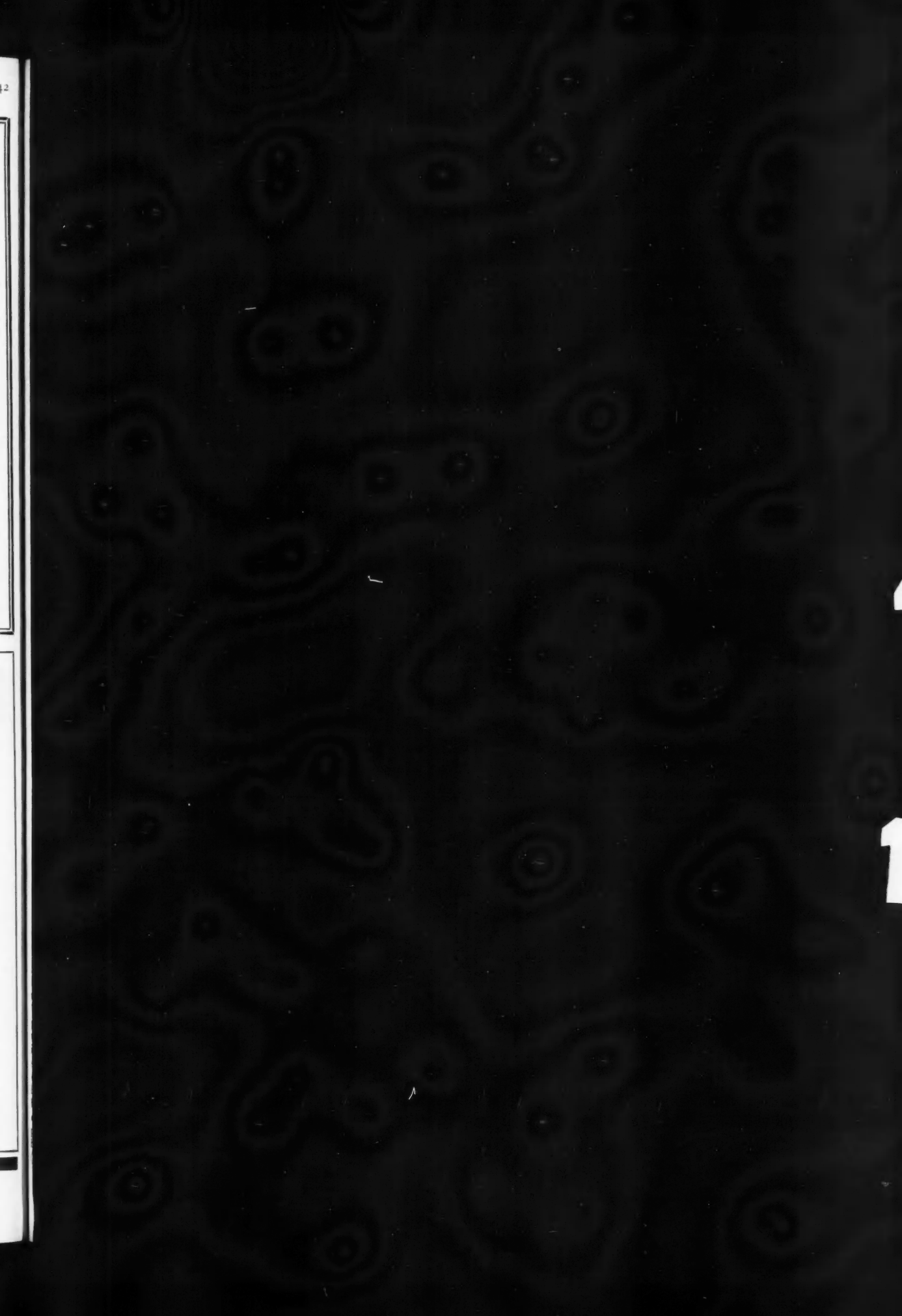

The Chemical Age

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The Utilisation of Gold

THE lines of A. E. Housman: "Oh tarnish late on Wenlock Edge, Gold that I never see!" might have been taken as the basic text for the very interesting and comprehensive paper which Mr. E. Downs gave on the subject of "Gold and its Scope in Industry" to the London Section of the Society of Chemical Industry. Gold occupies an anomalous position in industry. It is a rare metal and having been greatly sought after since the dawn of civilisation, and intensively prospected for during the past 50 years, it is doubtful whether it will ever become much more common than it is to-day. It possesses unusual and important properties which could render it of great value if it were not for the fact that it occupies in the esteem of mankind a peculiar place as the token of commercial value. For this reason it is doomed to be hidden in strong rooms, cunningly built for its reception, where it can be of no possible use to anyone. The technical problem that emerged from Mr. Downs' address was how to make use of the gold which has been extracted from its ores in order to be hidden away in man-made caves.

The world's output of gold, which has doubled since 1929, is about 1000 tons a year. This quantity of gold is to-day worth about £250 million. The total stock of gold in the world is reputed to be between £4000 million and £5000 million. Of this, only 5 per cent. is used in the luxury trades and in industry generally, the remaining 95 per cent. serving as the monetary standard. Among the major difficulties of using gold in industry is the fluctuation in its price, which depends so greatly upon whether a country is on or off the "Gold Standard." For example, when Great Britain was on the Gold Standard the price of gold was 85s. per oz. (troy), but when the country went off the Gold Standard in 1932 the price immediately increased to 110s. per oz. It has now been stabilised by the Bank of England at 168s. per oz. When gold was 85s. per oz. it began to come into industrial use to replace platinum for many purposes where corrosion-resistance was important and very high temperatures were not used. To-day, however, the price of platinum is 180s. per oz. and the incentive to use gold in place of platinum has almost vanished.

There are five properties of gold, it was pointed out at the meeting, that make it of peculiar value to the chemist and chemical engineer. These are: (1) Its nobility. Like platinum it is singularly resistant to all acids except aqua regia, and it has the peculiar advantage over silver in being resistant to sulphur. (2) It is of unusually high malleability and ductility. Since it can be beaten into very thin leaf or drawn into very thin wires it is possible to counteract its high price by making use of these properties. (3) It forms a firm joint with ceramics, as is well known to all who use gilt china ware. This opens the possibility of building up composite structures of metals with ceramics, the metals being built up on the gold and the ceramics being built up on the clay body to which the gold is attached. (4) It can be welded by pressure alone at ordinary temperature. (5) On account of its very low specific heat and latent heat of fusion it is easy to heat up and cool down. The production of gold from its ores has been revolutionised by the cyanide process, and although the yield of reef gold is of the order of 0.047-1.3 oz. per ton, the cost of operating the process of gold extraction is such that the cost of production is of the order of 30s. to 40s. per oz. with a maximum in Alaska of 62s. per oz. where the poorest ores are worked. Whether these prices are the minimum because further decrease in cost is unnecessary in view of the artificially high price of the product we do not know.

The uses of gold in the form of gold leaf, of rolled gold, of electrodeposited gold, and of gold plating by vacuum-tube deposition are established, and it is evident that complete corrosion-resistance can be obtained by using thin coatings of gold on industrial plant. The cost of this need not be high. Gold leaf, for example, can be beaten to such a thickness as only to contain one-sixteenth of a pennyworth of gold per sq. ft.

Mr. Downs, recognising the advantages of gold in industry, suggested that although gold equipment would tie up a lot of capital it would have a very high scrap value, and its use in, for instance, the manufacture of foods and medical chemicals would more than repay any small loss which might occur during the life of the plant. He asked whether it would not be possible for bankers who now have the gold stored in vaults to give it to industry on a lease-lend basis. It might be conceivable for a banker to release, for example, a ton of gold at a moderate rate of interest on the understanding that when the plant was scrapped any gold not returned to the bank would be paid for. The idea may seem far-fetched, but it was pointed out that, according to the new economic theory, many of our monetary difficulties are due to the fact that we do not separate the use of gold as a commodity from its use as a standard of value. Gold must be employed either for one purpose or for the other, but not for both together; it can have a real future as a article of commerce only if it is shorn of its financial importance. We should not be very bold if we predicted a complete change in the financial structure of the world after the war, and it may well be that gold will lose its key position in finance and the 20,000 tons of gold now in bank vaults throughout the world come to be liberated for useful purposes.

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NOTES AND COMMENTS

Less Tin for Bearings

OVER 2000 tons of tin annually, or nearly 10 per cent. of our consumption, finds its way into anti-friction (Babbitt) alloys for the lining of bearings. It is estimated that 65 per cent of this, that is, an amount equal to the entire output of the Cornish mines last year, can be saved if engineers, designers and others will help by applying certain recommendations of a committee of representative makers and users who have been investigating the matter for the Ministry of Supply. As it is important that this saving should begin now, all who instal or maintain bearings are earnestly asked to take the initiative immediately in their own workshops and bring their practice into line with war-time requirements. These requirements are set out in the committee's report which is available from the Non-Ferrous Metals Control, Grand Hotel, Rugby, or from the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Group Classification of Alloys

A FORM of immediate action which the manufacturers have voluntarily agreed to is the classification of bearings according to the severity of their service. They will supply Group 1 containing from 92 to 80 per cent. of tin only for the most exacting duties and Group 2 containing from 80 to 68 for less severe service. The range from 68 to 12 per cent. of tin will disappear "for the duration" and Groups 3 and 4, containing not more than 12 and 5 per cent. of tin respectively, will be supplied for much of the slower moving industrial machinery. A list has been compiled showing the group for which any particular class of machine qualifies. From now on designers are urged to abandon the use of solid cast (unbacked) bearings in favour of thin white metal linings bonded on to steel, brass or bronze backings. Such a change may effect an 80 per cent. economy of tin. At the same time it is pointed out that bronze backings or shells should not contain tin unless bearing properties are required in the shells; these thinner linings have superior load-carrying properties. Prompt co-operation by designers will greatly assist in the task of making our tin resources sufficient for our war-time needs.

Producer Gas to Replace Petrol

FOLLOWING the debate in the House of Lords quoted elsewhere in this issue, a scheme to save 150 million gallons of petrol annually by converting 50,000 road vehicles to run on producer gas was described at a conference held by the Mobile Producer Gas Association in London on Wednesday. Mr. J. W. Noel Jordan, the chairman, said that this was only a fraction of one motor transport fleet, and the extent of the saving of petrol would depend on the amount of fuel released and the quantity of gas producer equipment manufactured. The British Coal Utilisation Research Association, with assistance from Government Research Departments and industrial concerns, had evolved a producer gas plant which could be manufactured and used in large numbers. Imperial Chemical Industries had shown how the fuel gas could be made from certain kinds of British coke and anthracite. Intensive research had enabled a scheme to be laid before the Government which provided for a standardised gas produce that could be made in quantity with comparatively little labour, and fuel of the necessary quality could be manufactured at a number of centres in Britain.

Superpolyamides in Germany

Range of I.G. Products

A NUMBER of different superpolyamides—linear polycondensation products characterised by periodically repeated CO.NH groups and alkylene—are offered in the German market by I.G. Farbenindustrie under the trade name "Igamid." No full details of this group of synthetic resins are available, but some information has recently been provided. The "Igamids" differ from each other mainly in their solidifying points, solubility, and—consequently—certain properties of importance in industrial application. Igamid A (which is said to resemble nylon), B, and 6A form thin liquids when heated and cannot therefore be processed like other plastics, but there is Igamid 85B claimed to be thermoplastic over a sufficiently wide temperature range to permit treatment by normal processes. High resistance to heat, mechanical strength, fastness to light, easy dyeing, non-inflammability, and resistance to organic solvents are claimed as advantages of this and other Igamids. Some types of the material can be cast and pressed cold and warm, and—under suitable precautions—welded. Foils are made from Igamid 6A, while 40A is used as a lacquer on wood. Other uses are in adhesives and for insulating electrical cables.

The Igamid foils are supplied in thicknesses varying from 0.035 to 0.10 mm., in rolls with a width of 22 in. The material is said to be resistant against aromatic and halogenated hydrocarbons, esters, ethers, and ketones, though not against aliphatic alcohols and phenols. Their resistance to moisture is stronger than that of normal "cell glass," but their chief advantage as compared with cheaper transparent foils is the fact that they can be fastened by sewing like textile materials.

In this connection it may be of interest to mention new details about the two fully synthetic fibres available in Germany now. Pe-Ce fibre, which is made from acetylene, is stated to contain 64 per cent. of chlorine. It is resistant to nearly all acids and bacteria, non-inflammable, unaffected by water, and has a higher dielectric constant and heat insulation power than natural silk. It is equally strong in wet and dry condition, but it has the great disadvantage of a rather low solidifying point (between 80 and 90° C.) and, therefore, cannot be ironed. It is used largely for filter cloth, acid-resistant garments, fishing nets, and similar specialised applications. Perlon fibre, on the other hand, has a high melting point (270° C.). It is stated to embody foreign experience, in particular with nylon, and can be used in mixtures with other fibres. Strength and elasticity are stated to be better than in natural silk, the specific gravity is rather lower than those of wool, silk, and cotton. After the spinning process Perlon fibre is stretched to four times its former length. No information is available as to the principal uses of this material, which appears to be too expensive for general use.

Surplus Metal Stocks

Monthly Information List

IN order to speed up the output of war materials, the Ministry of Supply is issuing a monthly stock list containing details of surplus stocks of ferrous and non-ferrous metals. This is a means of making known to those engaged on work of national importance what quantities of surplus processed raw materials are available.

The items include metal such as sheet, plates, strip, joists, tees, channels, bar, tube, wire, and sections. On inquiry the intending purchaser is put in touch with the holder of the surplus material. If it is privately owned the parties are left to make their own arrangements with regard to price and delivery—subject to the general principle that the selling price shall be the controlled price and that no additional charges are permitted.

All holders of surplus stocks should send full specifications of the material available for disposal to the Directorate of Economy (Disposals), Steel House, Tothill Street, S.W.1, so that details can be published in the national list. Government contractors and sub-contractors should ensure that they receive a copy of the list each month. This list does not include surplus aircraft material, which will continue to be dealt with by the Ministry of Aircraft Production.

Developments in Lignin Chemistry*

Sidelights on Recent Work

As far back as 1897 Klason maintained that lignin is almost certainly related to coniferyl alcohol, and is consequently an aromatic substance. This idea later proved to be both stimulating and mainly true, and one can say without exaggeration that nearly everyone lately who has seriously studied the chemical structure of lignin has come to the same conclusion. Hilpert took exception to this, however, and pointed out that wood, particularly from deciduous trees, as well as straw, is almost entirely soluble in cold concentrated hydrochloric acid. Only after a lapse of time does the lignin separate. As many carbohydrates are transformed under similar treatment into dark-coloured products—carbohydrate-humic-acids—which resemble lignin preparations in many respects, Hilpert drew the conclusion that lignin isolated by means of acid consists of degradation products of certain carbohydrate components of the wood, which are capable of being acted upon by acids, thus denying completely the separate existence of lignin as such. Hilpert's observations—in principle not new—are probably due to the circumstance that the native lignin in wood is combined with the carbohydrates, being either wholly low-molecular or glycosidal, and therefore soluble in acids. By prolonged reaction with acid polymerisation of the hydrolysis products of the lignin-carbohydrate complex takes place, and insoluble acid-lignin is in consequence precipitated.

Native lignin may be hydroaromatic, and related, *e.g.*, to inositol, quinic acid, and similar substances, which are easily dehydrated to form aromatic bodies. This question is at present under investigation at the Central Laboratory of the Cellulose Industry at Stockholm. Comparison of the chemical reactions of isolated lignin, wood and carbohydrate-humic-acids, made by P. N Odinzov, seems to indicate that lignin is a definite component of wood.

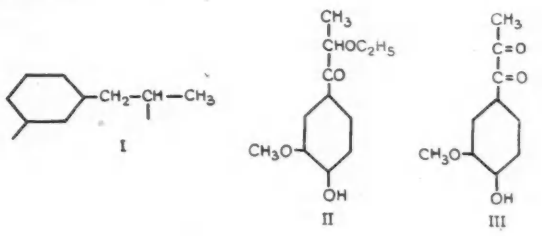
Analytical data from various sources indicate that isolated lignin contains 65-66 per cent. carbon and 6 per cent. hydrogen. The rest is oxygen. Lignin from hardwood contains, as a rule, 5 per cent. less carbon. B. Holmberg has found by extensive investigations—not yet given the recognition they deserve—that lignins from the most varied plant groups are mainly of the same general composition.

The Nature of Oxygen in Lignin

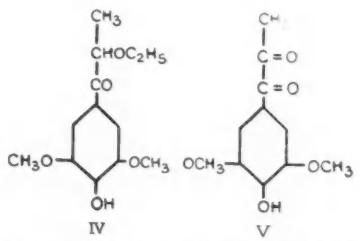
The oxygen present in lignin occurs in different groups. Softwood lignin, for instance, contains c. 15 per cent. or more of methoxyl groups. Hardwood lignin is richer in methoxyl groups (21-22 per cent.), which accounts for its lower carbon content. Hydroxyl groups amount to c. 9 per cent. in fir lignin, of which the greater part (6-7 per cent.) are secondary and c. 2 per cent. are tertiary. The rest of the oxygen is without functional properties and appears, therefore, clearly as ethereal oxygen (c. 7.5 per cent.). Aldehyde and carbonyl groups have not been clearly indicated. By measurement of the amount of acetic acid formed by oxidation of lignin with chromic acid, it can be shown that it contains at least 2.7 per cent. of methyl groups in combination with carbon. As this proportion is as nearly as possible equivalent to the percentage of tertiary hydroxyl groups in the lignin, it is reasonable to assume that these groups are related to one another as $S-C(OH)(R^1)-CH_3$ groups. Free phenolic hydroxyl groups appear only in small proportions about equal to the tertiary hydroxyl groups.

If all the oxygen atoms (in the OCH_3 and CH_2O_2 groups) in lignin are taken as being replaced by hydrogen, the basic lignin hydrocarbon is obtained, the calculated composition of which corresponds to the empirical formula C_9H_{10} or one molecule of phenylpropane minus two atoms of hydrogen, as in (I). Lignin can thus be built up from such simple units, united with one another either directly or by means of oxygen atoms.

Of particular interest among natural substances derived from phenylpropane are some that have recently been isolated from different woods and plants by Hibbert and his collaborators. By combination of the extracted plant-matter with ethyl alcoholic HCl they obtained, besides a lignin containing an ethoxy group (the so-called ethanol lignin, of high molecular weight), a small number of distillable fractions from which the following substances were derived, from spruce (II, III) and from maple (II, III, IV, V).



I II III



IV V

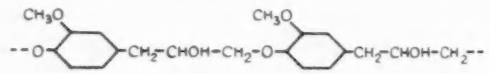
The ethyl groups in the substances (II) and (IV) are derived from the added ethyl alcohol, and since they can be isolated by ethanolysis the indications are that they were present in the original wood in glycosidic union with simple sugars or polysaccharides. The substances (III) and (V) consist of dehydration products of those alcohols which are the foundation of the ethyl ethers (II) and (IV). It is uncertain whether the diketones (III and V) are secondary oxidation products, or whether they occur in the wood in glycosidic combination with the hydroxyl groups of the carbohydrate. All these substances may contribute to the varied "lignin reactions" of wood.

Hibbert believes that he has found the real building units of lignin in these compounds, but this is not at all certain. It is true that they can be polymerised into insoluble products by the usual methods of determining lignin and are included in the total amount of the lignin, but it does not follow that these polymerisation products are identical with the true acid lignin. What makes these substances so interesting in the chemistry of lignin is that they, more than other similar compounds, appear to accompany lignin, and are characteristic of lignified material. It is, therefore, reasonable to assume that these are stable products of prototypes that constitute direct forerunners in the biosynthesis of lignin. Their discovery and investigation must be considered one of the major results of the scientific study of lignin during recent years. They constitute valuable support for the likelihood of the many speculative, and often revised, ideas about the structure of lignin, which for more than a decade have been developed by Freudenberg and which are here briefly outlined.

Assuming from the analytical results that with every methoxyl group—and, as these are combined with aromatic nuclei, with every nucleus as well—there will be found an aliphatic hydroxyl group, not a phenolic hydroxyl

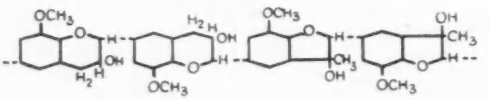
* From a lecture given at the annual meeting of the Society of Finnish Paper Engineers on April 26, 1941, by Holger Erdtman, Ph.D., of the Cellulose Industry Central Laboratory, Stockholm Technical College.

group, but instead one with an additional ether-bound oxygen atom over and above the oxygen atom of the methoxyl group; assuming further that lignin is a derivative of phenylpropane, the conclusion can be drawn that it is a polyether of the following type:



VI

It may well be surmised that if lignin had so simple a structure the question of its constitution would have been solved long ago. Such a substance should by hydrolysis, *e.g.*, with strong alkali or mineral acid or by reduction with hydriodic acid and phosphorus, undoubtedly give a high percentage of simple degradation-products of the phenylpropane type. Freudenberg has refused to accept so simple a scheme and dismisses even those condensation principles that make use of acetal links between units. Only the presumption of a chain of carbon-carbon bonds can satisfactorily explain the resistance of lignin to hydrolytic and other forms of breakdown. A structure of the following type is then more correct:



VII

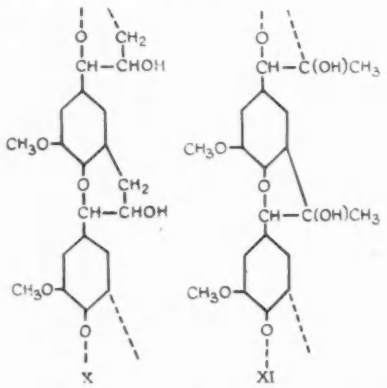
CH_3-C-OH groups enter the two right-hand ring-systems in accordance with the results of chromic-acid oxidation. A hydrolytic or reduction degradation, *e.g.*, by potassium permanganate, must affect the free hydroxyls and thereby break the carbon chains. By continued oxidation of the aliphatic chains, the phenol-hydroxyl groups in the aromatic nuclei are liberated, whereby these nuclei are exposed to the attack of potassium permanganate and are quickly and completely decomposed. Freudenberg has gone to great lengths in order to form a theory about the biosynthesis of lignin from these type substances, presuming a continual condensation of low-molecular entities. He imagines that the latter consist of 3:4 dioxyphenyl-propane derivatives, which in the side chains contain three hydroxyl groups or one hydroxyl group and one carbonyl group ($:C(OH)_2 \longrightarrow :CO + H_2O$), especially the following:

VIII IX

Through continual condensation of these elements with themselves or one another, types of mixed ethers should appear, which, by intro-molecular condensation, should be transformed into (X) and (XI).

Against these speculative assumptions a few objections might not be out of place. Ethers of the types concerned are known to possess in a high degree the ability to react with the CH-group in *para*-position to the methoxyl group. A more likely course of condensation would therefore be that the OH-group of the side-chain should react with a parallel-lying molecule in *para*-position to the OCH_3-group. This should lead to products from which, through oxidation, one would expect the formation of a phthalic-acid derivative and not the *iso*phthalic-acid derivative, which actually is obtained.

Formation of the heterocyclic ring systems in VII appears therefore to require a special reaction mechanism. Moreover, the transition to Formula X appears to be untrue because condensation of the kind presumed does not as a rule occur with alcohols whose hydroxyl groups do not lie close to the carbon atoms adjoining the aromatic nucleus. Benzyl alcohol, and better still oxybenzyl, are,



X XI

as is well known, easily subject to such condensation (for instance, in the formation of Bakelite).

(To be continued)

Oil and Colour Chemists

London Section Annual Meeting

THE annual meeting of the London Section of the Oil and Colour Chemists' Association was held at the offices of the Federation of British Industries, Tothill Street, on April 24. Dr. H. W. Keenan, chairman of the Section, presided. Mr. W. Garvie, Mr. N. A. Bennett, and Mr. E. H. Davies were elected to the committee to fill vacancies caused by the retirement of Mr. G. F. Jones, Mr. R. L. Ledwith, and Mr. T. Drummond Kerr. The meeting unanimously re-elected officers as follows, and cordially thanked them for their services during the past year: Hon. Secretary, Mr. David E. Roe; Hon. Treasurer, Mr. G. C. Attfield; Hon. Publications Secretary, Mr. H. A. Idle. Dr. Keenan was elected chairman of the section for the third year.

The report of the committee showed a satisfactory state of affairs. The membership during the year ended December 31, 1941, showed a net increase of 34. The decrease in enemy activity lessened the need for the operation of the London Regional Emergency scheme as centralised activities have been possible. Furthermore, experience gained during the first 12 months of the scheme has enabled a more satisfactory arrangement to be devised and plans are in existence for the scheme to come immediately into operation should another emergency arise. Considerable headway has been made by the London Regional Emergency Groups in Bristol, Hull, and Newcastle, and satisfaction is expressed that the interest shown in Newcastle was sufficient to warrant the formation of a new Section of the Association. During the year two lectures on "Inorganic Chemistry" were given as the inauguration of a plan to bring members of the London Section up to date in the various branches of pure chemistry. Arrangements have been made for the continuance of this scheme during the coming session and it is hoped to make this one of the regular activities of the section. Among the subjects which have been discussed by the committee are technical education in the industry and the role of the association in war time. In both cases, recommendations were forwarded to the Council and the appropriate steps have been taken.

After tribute had been paid to the late Mr. F. W. Clark, whose ship was torpedoed en route for America, the chairman opened a general discussion on "The Sociological Outlook," saying that it was in the nature of an experiment, and the course of action in future would be judged by the way in which this discussion took place.

New Control Orders

Coal-Tar Products

THE Secretary for Mines announces that the Board of Trade has made the Control of Coal Tar Order, 1942 (S.R. and O. 1942, No. 732). This came into force on May 1 and supersedes the Control of Coal Tar Order, 1941 (S.R. and O. 1941, No. 81). The increasing importance of coal-tar products to the war industries has necessitated the assumption of a wider form of control. The main provisions of the 1942 Order are :—

1. The Secretary for Mines will continue to control by licences the acquisition of coal tar in quantities exceeding 50 gallons at a time and more in the aggregate than 250 gallons in any one year. Coal tar may be treated, used or blended only under the authority of a licence, with the exception of blending by producers.

2. The disposal of all coal-tar products by distillers and importers will be subject to licence.

3. The Secretary may in relation to coal-tar products direct that any product specified in the direction may not as from the date specified therein be acquired without a licence.

4. The Order empowers the Secretary to give directions regarding the disposal, treatment, use and blending of coal tar and coal-tar products, and provision is made as to the price at which directed material shall be sold or supplied.

5. Provision is made for the prohibition of the sale of any coal-tar product as specified in a direction given by the Secretary after a date specified therein except by distillers, importers, or registered sellers, and for the registration of such sellers.

The provisions in the Control of Coal Tar Order, 1941, dealing with general price control are not included in the new Order as it is proposed to fix prices in separate Orders when necessary.

Prices of Coal-Tar Products

Four further orders controlling the prices of coal-tar products likewise came into force on May 1. These are :

1. The Coal Tar Acids Prices (Inland) Order, 1942 (S.R. and O. 1942, No. 731), relating to the prices of coal-tar acids for home consumption only. Under the Order no person may sell or supply coal-tar acids mentioned in the Order at prices exceeding the maximum prices therein, and no person may sell or supply coal-tar acids not specified in the Order without the permission of, and at the price fixed, by the Secretary for Mines. Provisions are included in the Order regarding containers, and, in cases in which delivery is not taken at the seller's works, transport charges. A clause permits the re-sale by merchants of certain coal-tar acids at a maximum price of 3 per cent. in excess of that specified in the Order. Phenol and mixtures containing 80 per cent. and over of phenol have been excluded from the provisions of the Order because of price agreements between the Government and the trade already in operation.

2. The Anthracene Prices Order (S.R. and O. 1942, No. 733) is similar in substance to the direction under paragraph 8(1) of the Control of Coal Tar Order, 1941 (S.R. and O. 1941, No. 81), which it supersedes, but provision is made for the sale or supply of crude anthracene or unrefined crude anthracene, of a quality unsuitable for the manufacture of dyestuffs, at a maximum price which is lower than the actual fixed price applicable to the sale or supply for such manufacture. The Secretary for Mines may also, in exceptional circumstances, mentioned in the Order, fix prices higher than those specified in the Order. Anthracene will continue to be subject to the provision of the General Control of Coal Tar Order and disposal licences for off-standard paste will only be granted when material is definitely unacceptable for dyestuffs manufacture.

3. The Naphthalene Prices (Inland) Order, 1942 (S.R. and O. 1942, No. 736), supersedes the direction under paragraph 8(1) of the Control of Coal Tar Order, 1941 (S.R. and O. 1941 No. 81), in that provision has been made to include naphthalene with a melting point below 50° C. The Secretary may, in exceptional circumstances, fix prices higher than those specified in the Order. Provision has also been made for an increased price to be charged for the sale of naphthalene in small quantities, the additional allowance being subject to the size of the parcel. The position with regard to transport charges and containers has also been modified. Naphthalene will continue to be subject to the provisions of the General Control of Coal Tar Order.

4. Under the terms of the Road Tar Prices (Inland) Order, 1942 S.R. and O. 1942, No. 659), no person may sell or supply road tar otherwise than at the fixed prices quoted, which are based on regional schedules and types of container used, and may be increased for the sale or supply of road tar in small quantities. Road tar, as defined, includes road tar-bitumen mixtures containing up to 10 per cent. of bitumen, and provision is made for the Secretary to fix by direction an additional charge for such mixtures above the fixed prices quoted. Provision has also been made whereby proprietary brands of road tar sold under a mark on or before June 30, 1941, and approved by the Secretary, may be sold at an additional price not exceeding 1½d. per gallon. The Secretary may in exceptional circumstances fix prices higher than those specified in the Order. Road tar will be subject to the provisions of the General Control of Coal Tar Order.

All communications in respect of any of the above Orders should be addressed to the Coal Tar Controller, Quebec House, Quebec Street, Leeds, 1, and copies may be purchased from any bookseller, or directly from H.M. Stationery Office.

Prices of Invert Sugar

The Ministry of Food announces that the maximum wholesale prices of invert sugar are increased by 9d. per cwt. from April 27. The revised maximum prices are as follows: Invert No. 1 sugar, 51s. 6d. per cwt. net weight; No. 2, 50s. 6d. per cwt. net weight; No. 3 (including black), 49s. 6d. per cwt. net weight.

Industrial Alcohol

The Minister of Supply has made the Control of Molasses and Industrial Alcohol (No. 16) Order, 1942, which came into force on May 1, reducing the minimum quantity of industrial alcohol (other than mineralised methylated spirit) above which dealings are subject to licence. Licences will now be necessary for quantities exceeding in the aggregate one gallon in any period of one calendar month.

Birmingham Chemists' Meeting

Dr. Fox on Modern Chemical Methods

AN open meeting of the Birmingham and Midlands Section of the Institute of Chemistry was held in Birmingham last Saturday. It was attended by members of the Society of Chemical Industry, the Birmingham University Chemical Society and the British Association of Chemists. The President of the Institute (Dr. J. J. Fox) dealt with recent applications of modern chemical and physical methods as applied to investigations and analyses of products in industrial laboratories. He illustrated his lecture by describing spectrographic methods of analysis of metals and alloys, referring to the large number of analyses that can be carried out with great expedition and with sufficient accuracy for most analytical requirements.

In proposing the toast of "Chemistry," Mr. Kenneth Chance avowed that chemists should declare that after the war they would never again use their knowledge for the making of munitions of war except under international guidance. Such a decision would be of great help to the makers of the peace. Dr. Fox, in response, said he believed that out of discoveries made during the war economic advantages would arise. He was perturbed about the post-war position in respect of young people now engaged on war work. Whatever the cost, those young people must be given a chance for proper training for the work they will have to do in the future.

Personal Notes

MR. H. L. JOHNSON, a managing director of Courtaulds, Ltd., was last week elected president of the Textile Institute.

MR. ROBERT BARLOW, chairman and managing director of the Metal Box Company, has been appointed by Mr. Oliver Lyttelton as chairman of the panel, composed partly of leading industrialists and partly of labour experts, to deal with the production division of his office.

At the last Council meeting of the Society of Chemical Industry it was agreed with acclamation that DR. B. CONANT, President of Harvard University, DR. T. MARSTON BOGERT, of Columbia University (president of the Society in 1912-13), and DR. BERNARD DYER (an original member of the Society) should be asked to accept honorary membership of the Society. The President announced that SIR JOHN RUSSELL had agreed to be the recipient of the Messel Medal.

Obituary

MR. FELIX BERK, who died in London on April 29 at the age of 61, was chairman of F. W. Berk and Co., Ltd., and president of their associated American company.

We regret to announce the death on April 25, at Bushey Heath, Herts, of MRS. ELIZABETH ISHERWOOD, wife of DR. P. C. C. ISHERWOOD, O.B.E., F.I.C., who is chairman and managing director of W. J. Bush and Co., Ltd.

MR. CHARLES F. MOORE, governing director of Swift and Company Pty. Ltd., specialists in industrial chemicals, Sydney, died in Australia on January 8. Mr. Moore joined the company in 1905, became a director eight years later, and was appointed governing director in 1930.

DR. HERBERT LISTER BOWMAN, M.A., D.Sc., who died at Oxford on April 22, aged 67, had been Waynflete Professor of Mineralogy and Crystallography at Oxford University from 1909 to 1941. His writings in the field of mineralogical research dealt especially with the crystalline form and chemical character of minerals, including many of the rarer varieties; extreme skill and accuracy characterised all his work, and his pupils will remember him as a careful and painstaking master.

Chemical Matters in Parliament

Aluminium and Light Alloys

IN the House of Commons last week Mr. Ellis Smith asked the Minister of Aircraft Production whether the supply of aluminium and light alloys was satisfactory; what refunds had been made by the industry to the Ministry; what was the average profit; and whether there were satisfactory relations between the industry and the Ministry. Colonel Llewellin replied that as regards refunds and average profits, there were several industries and several hundred firms concerned in the production of aluminium and light alloys. Price adjustments had in some cases resulted in payment to the Ministry and in others by the Ministry, but the subject was highly complicated and one with which it was not possible to deal within the scope of an answer to a parliamentary question. The answers to the first and last parts of the question were in the affirmative.

Mr. Smith then asked if the House could be informed of the average profits of the firms in this association which have created so many difficulties for the Ministry.

Colonel Llewellin: There are very large numbers of firms making aluminium and magnesium castings and strips and other different components, and it is very difficult to obtain an average for all of them which would have any real relevance to the facts.

Sir Richard Acland: Can the Minister say whether these people have yet allowed costing officers to go into their factories and find out for themselves what are the costs?

Colonel Llewellin: Negotiations on these price matters are going on, and I have not the slightest doubt that our people have been in the factories, but, without notice, I would not like it to be said that they have.

Salvage of Waste Engine Oil

Sir Irving Albery asked the Secretary for Petroleum whether any new refineries had been erected for the salvage of waste engine oil; whether the existing refineries had adequate transport facilities; and whether he was aware that the motor trade had received no instructions to save waste oil, and had been dumping it through lack of storage space. Mr. Lloyd replied that three refineries had been completed during the last few months. The collection of waste oil from garages necessarily involved a transport problem and every effort was being made to overcome this by organising collection by areas. Assistance was being given wherever possible by the Petroleum Board, which was organising a scheme of collection from garages.

Producer Gas Units

In the House of Lords on Tuesday, the Duke of Montrose moved that a scheme for converting 50,000 transport vehicles to producer gas propulsion, with a view to saving 500,000 tons of petrol for the fighting services, should be prepared and put in force as soon as possible. It was imperative, he said, that something should be done now to provide an alternative to petrol. Referring to the producer gas unit brought out by the Government, he said the Government design had been an absolute failure.

Lord Leathers, Minister of War Transport, said that the Government would have done much harm if they had rushed into operation an ill-conceived or hastily devised scheme, which would have caused loss of industrial effort in production and reduced efficiency in road transport. They had recently received two reports, one from the Hindley Committee and the other an interim report specially called for from the technical committee on producer gas. For security reasons he could not make these reports public, but they were of great value. The Government had decided that immediate action should be taken to require operators to equip as soon as practicable 10,000 commercial vehicles with the Government producer apparatus. The new improved producer was the result of experiments, and was recommended for adoption by the technical committee. Before making that recommendation they had had under review every producer in operation.

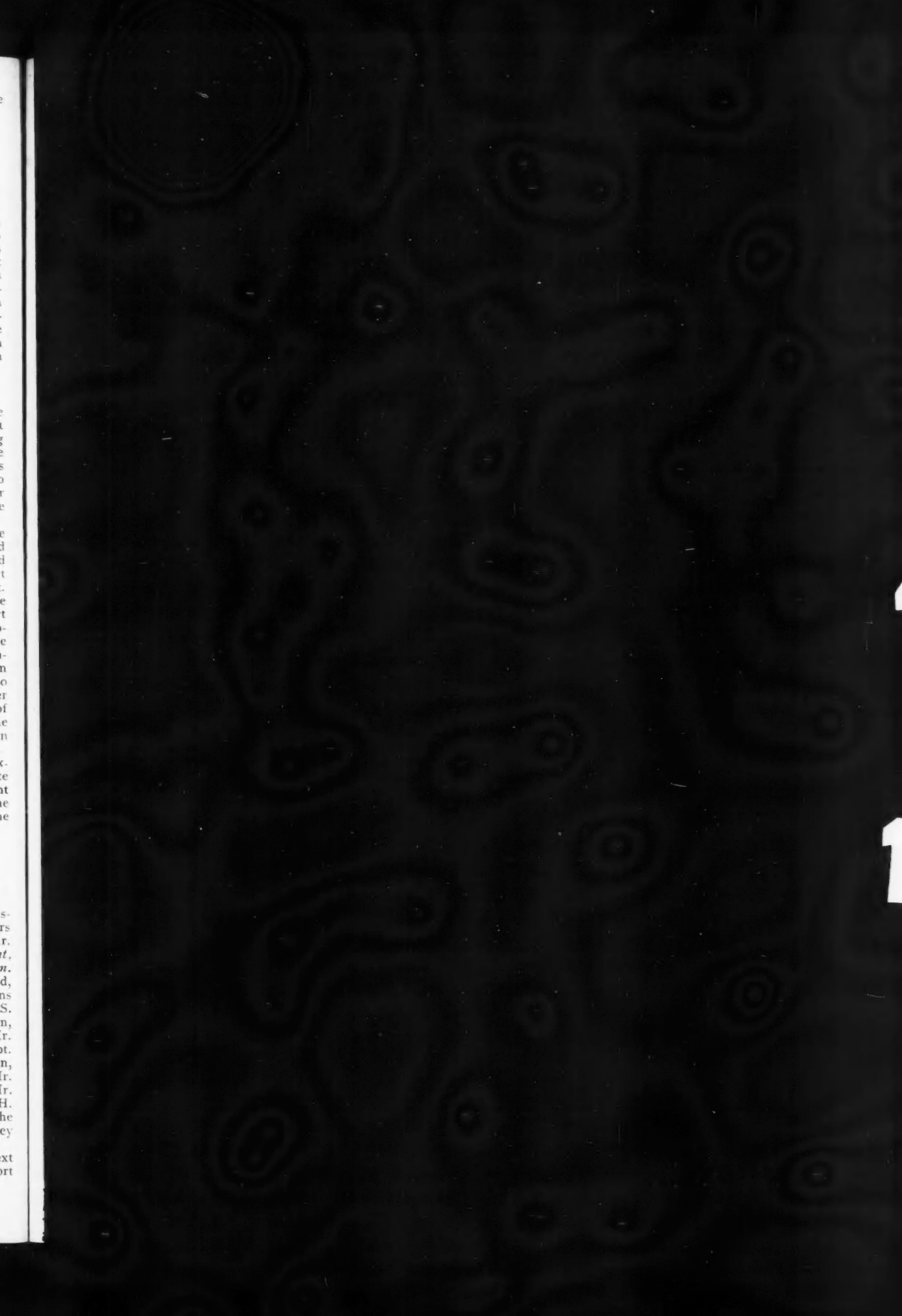
After further debate, the Duke of Montrose, having expressed himself dissatisfied that producers made by private firms were not to have equal priority with the Government apparatus challenged a division on his motion. The motion was carried by 20 votes to 19, a majority of one against the Government.

Association of Tar Distillers

Election of Officers

AT the annual meeting of the Association of Tar Distillers held in London last week the following officers and executive committee were elected: *President,* Mr. C. E. Carey, South Metropolitan Gas Co.; *Vice-president,* Mr. S. Billbrough, Yorkshire Tar Distillers, Ltd.; *Hon. Treasurer,* Captain Harriss, Burt, Boulton and Haywood, Ltd.; *Hon. Auditor,* Mr. E. Hardman, E. Hardman, Sons and Co., Ltd. *Executive Committee*: (Scotland) Mr. S. Hilton, Mr. J. Simpson; (N.E. Coast), Mr. J. Colligon, Mr. W. A. Walmsley; (N.W. Coast), Mr. J. R. Lane, Mr. C. A. Murray; (N. Midlands) Mr. S. Billbrough, Capt. C. F. Ward Jones; (S. Midlands) Mr. R. B. Robinson, Mr. W. H. Phillips; (London and S.E. Counties), Mr. J. H. Olliver, Maj. A. G. Saunders; (S.W. Counties), Mr. H. H. Bates, Dr. T. H. Butler; (Wales), Sir Charles H. Bird, Mr. C. F. Dutton; together with the President, the Vice-president, and Col. W. A. Bristow and Mr. Stanley Robinson (Past Presidents).

Restrictions of space oblige us to hold over until next week a summary of the very interesting annual report which the Association has just issued.



Metallurgical Section

Published the first Saturday in the month

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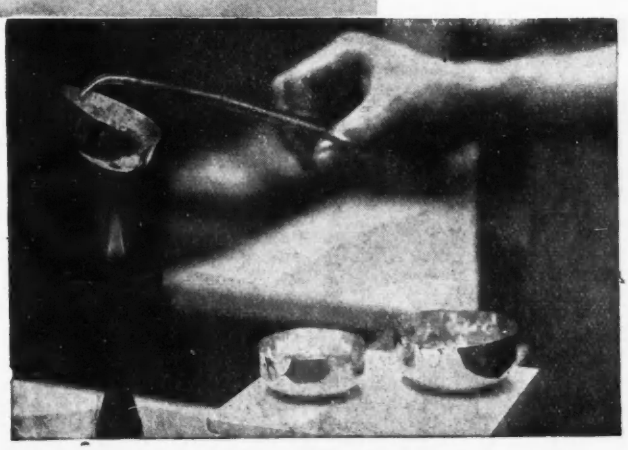

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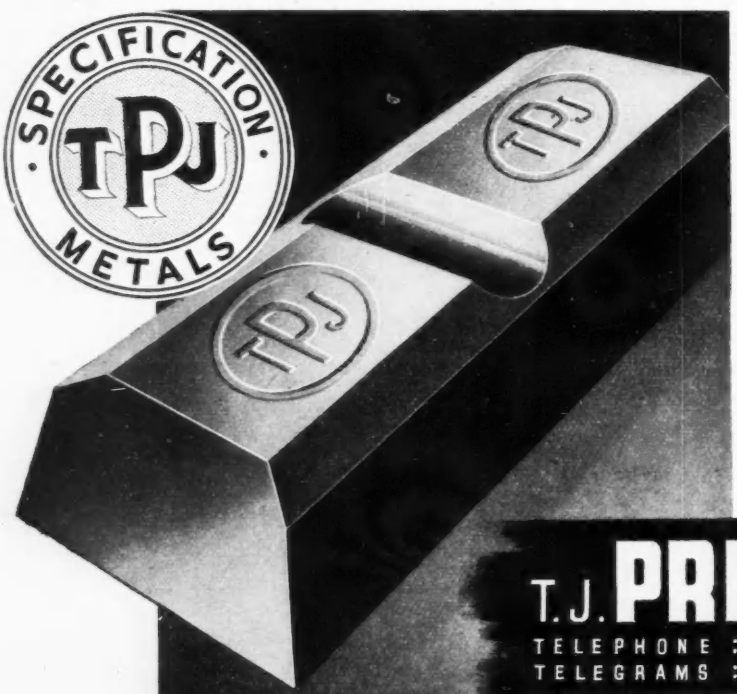

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Metallurgical Section

May 2, 1942

FLUXES FOR ALUMINIUM ALLOYS, II

Precepts for Melting, Welding, and Soldering

by OTTO EINERL, Dr.Eng., and FREDERIC NEURATH, Ph.D.

(*Continued from The Chemical Age, April 4, p. 183*)

THE alkaline and alkaline earth chlorides, used alone, have fairly high melting points, but usually low specific gravities:

NaCl	(m.p. 802° C.,	sp. gr. 2.16)
KCl	(m.p. 800° C.,	sp. gr. 1.98)
$MgCl_2$	(m.p. 718° C.,	sp. gr. 1.66)
$CaCl_2$	(m.p. 768° C.,	sp. gr. 2.15)
$SrCl_2$	(m.p. 840° C.,	sp. gr. 3.05)
$BaCl_2$	(m.p. 960° C.,	sp. gr. 3.87)

Their mixtures, however, give more or less low melting eutectics as: 56 % $CaCl_2$ + 44 % KCl (m.p. 487° C., the composition of carnalite), 73 % $CaCl_2$ + 27 % NaCl (m.p. 505° C.), and 55 % KCl + 45 % NaCl (m.p. 645° C.).

Ternary eutectics are: 70 per cent. $CaCl_2$ + 25 per cent. NaCl + 5 per cent. KCl (m.p. 495° C.); and 50 per cent. KCl + 20 per cent. NaCl + 30 per cent. $CaCl_2$ (m.p. 530° C.). The above-mentioned eutectic mixtures are mostly used as bases for flux mixtures for aluminium alloys, and these mixtures contain generally from 4 to 6 different salts.

Calcium chloride shows, at about 820° C., a good dissolving power for SiO_2 (about 3 per cent.), but this proves sometimes rather a disadvantage, especially when melting aluminium turnings or borings rich in silicon and oxidised by corrosion. The reaction which takes place is the following: $2CaCl_2 + Al_2O_3.2SiO_2 = CaSiO_3 + CaAl_2O_4 + SiCl_4$. The calcium silicate (wollastonite) and calcium aluminate thus formed, both with high specific gravity and very high melting point (1540° C.), soon make the flux so viscous that it has to be changed.

The addition of titanium chloride, potassium titanium fluoride, or alkaline double fluorides of boron, zirconium, or thorium to the flux mixtures causes a degasification, while at the same time small quantities of the alloying metals enter the aluminium and effect a grain refinement.

Degassing Effect

If the degassing effect alone (connected with vigorous ebullition of the metal bath) is desired, organic chlorides or bromides can also be employed, as well as chlorine gas or nitrogen. Suitable organic compounds are: Carbon tetrachloride, CCl_4 (b.p. 77° C.), tetrachloroethylene, C_2Cl_4 (b.p. 121° C.), hexachloroethane, $CCl_3.Cl_3C$ (m.p. 185° C., sp.gr. 2.00), hexachlorobenzene, C_6Cl_6 (m.p. 226° C., sp. gr. 2.04), hexabromobenzene, C_6Br_6 (m.p. 315° C.).

Furthermore, carbon disulphide CS_2, (b.p. 46° C.), sulphur, and thiocarbonyl chloride (thiophosgene) $CSCl_2$ (b.p. 73° C.) are recommended and used, either alone or in mixture with ammonium chloride or ammonium bifluoride. In principle, all compounds that give off gases which are insoluble in aluminium can be used.

Refining Action

Such organic compounds also figure prominently in the removal of magnesium from duralumin or other magnesium-containing aluminium alloys. For this it is necessary first to overheat the molten metal, so as to cause a partial oxidation of the magnesium to its oxide, or, in the presence of magnesium chloride, to magnesium oxychloride, at the same time sacrificing part of the aluminium alloy to be refined. Or cryolite, of which 6 lb. are necessary to remove 1 lb. magnesium, may also be added, with the following effect:

$$Na_3AlF_6 + 3Mg = 2Al + 3MgF_2 + 6NaF$$

U.S.P. 2,239,277 of 1941 brings about the removal of impurities such as Sb, Sn, Pb, or Bi from aluminium scrap by stirring 0.1 to 1 per cent. sodium into the molten metal with subsequent separation of the skimmings. It is moreover possible to use sodium in excess and to eliminate a surplus of the used sodium by addition of fluxes which contain sodium silicofluoride:

$$Na_2SiF_6 + 4Na = 6NaF + Si$$

and the originating metal dissolves in the aluminum.

If alloy scrap has to be melted down, where the magnesium content is to remain as high as possible (e.g., BA 29, DTD 300, NA 350, etc.) it will thus be advisable, to omit the cryolite as well as the sodium silicofluoride from the fluxes. For such alloys recommended fluxes consist of 40 – 70 per cent. $MgCl_2$, 25 – 35 per cent. KCl, balance NaF and CaF_2:; or 62 per cent. $SrCl_2$, 20 per cent. $ZnCl_2$, 10 per cent. KCl, and 8 per cent. CaF_2.

B.P. 539,023 and 539,024 cover fluxes with the following composition for aluminium alloys with high magnesium content and for aluminium-containing magnesium alloys: 20 – 50 per cent. $MgCl_2$, 25 – 40 per cent. $CaCl_2$, up to 30 per cent. NaCl, up to 30 per cent. KCl, and 0–5 per cent. magnesium oxide; or 30–50 per cent. $MgCl_2$, 8–16 per cent. $CaCl_2$, NaCl and KCl together up to 15 per cent., 15 – 25 per cent. CaF_2, and 5– 20 per cent. magnesium oxide.

Welding Fluxes

Though the foregoing details refer chiefly to the melting of aluminium alloys, they are also the basis for the consideration of the arc welding and gas welding of aluminium and its alloys.

Fluxes for welding require a further reduction of their melting point, which can be brought about by lithium chloride (m.p. 606° C., sp. gr. 2.07), or less successfully with lithium fluoride (m.p. 801° C., sp. gr. 2.60).

The composition of eutectic salt mixtures with lithium chloride and the melting points so obtained have been very little investigated. A ternary eutectic mixture in the system NaF – KCl – LiCl may come near to 33 per cent. NaF + 34 per cent. KCl + 33 per cent. LiCl.

The Air Board Specification L13 stipulated for aluminium welding the following flux: 30 per cent. NaCl + 15 per cent. LiCl + 45 per cent. KCl + 7 per cent. KF + 3 per cent. $KHSO_4$, whereas the specification DTD110 altered the mixture as follows: 22 per cent. NaCl + 15 per cent. LiCl + 50 per cent. KCl + 10 per cent. KF + 3 per cent. $KHSO_4$; other recommended mixtures are 13 per cent. NaCl + 20 per cent. LiCl + 63 per cent. KCl + 4 per cent. K_2SO_4; and 58 per cent. LiCl + 30 per cent. GF + 12 per cent. HPO_3 (U.S.P. 2,171,041).

A further factor, which does not concern the melting of aluminium alloys, but which is essential in the welding process, is the spreading power, *i.e.*, the ability of the molten flux to spread quickly over the surface of the metal which it is to protect. Much research was published last year on this subject by the Committee on the Weldability of Non-Ferrous Metals, carried out in the laboratories of the

British Non-Ferrous Metals Research Association in collaboration with the Institute of Welding.

Fluxes for Soldering

The fluxes for hard soldering are in the main the same as those used for autogenous welding and they are modified only by reducing their effective temperature to the lower working temperature which is sufficient for the hard soldering of aluminium alloys. Hard solders for aluminium alloys have a high aluminium content, and therefore melting points between 540 and 600° C. Often organic materials such as tallow, rosin, etc., and sometimes zinc chloride are used as components for these mixtures.

For soft soldering of aluminium alloys, alloys consisting essentially of low-melting alloys containing the heavy metals tin, zinc, cadmium, calcium, lead, with additional silver, bismuth, antimony, etc., are in general use. These alloys, which contain from 0 per cent. to 50 per cent. of aluminium, have melting points ranging from 150 to 400° C., according to the purpose for which they are required.

For the removal of the oxide film, zinc chloride (m.p. 290° C., sp. gr. 2.90) is generally used, or where an even lower melting point is required, the eutectic mixture of 72 per cent. $ZnCl_2$ + 28 per cent. NH_4Cl (m.p. 179° C.) A variety of these soft solders is the "reaction solders," used in the form of powder or paste, from which the soldering alloy separates, when heated, from a mixture of salts containing zinc chloride or tin chloride, acting at the same time as a flux.

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ERRATA (*in Part 1*)

p. 182, col. 2, l. 31: *For* 29, *read* 2.9.
" " l. 35: *For* $Cu(BO_2)_2$, *read* $Cu(BO_2)_2$.
" " l. 37: *For* $Al(BO_2)_2$, *read* $Al(BO_2)_3$.
p. 183, col. 1, l. 9: *For* $MgZn_3$, *read* $MgZn_2$.
" " l. 15: *For* I.23, *read* I.33.
" col. 2, l. 28: *For* Al., *read* Al.

The German Metal Position

Meeting Tin and Antimony Deficiencies

THE revision, which is now incumbent upon us, of the allocation of certain metal supplies, has been a growing concern of Germany since the outbreak of war, and a summary of the measures taken in the Reich to provide adequate substitutes for such metals as tin, antimony, and tungsten, is not without its value to British metallurgists. Recent German practice on these lines is detailed in some notes from the European correspondents of *Chemical and Metallurgical Engineering* (*49,* 2, p. 149) and a few extracts from these are appended here.

Since most of Germany's normal sources of tin were written off when the Nazi war plans were first made, a readjustment has been under way for at least five years. Most of the tin used went into plating sheets for packing foodstuffs, lesser amounts into tinfoil and distillery pipes, and some was used for bronze and bearing-metal alloys and type metal. Metal food containers are now made entirely of black sheet iron or aluminium, and are reported to be unsatisfactory in many respects. Tinfoil used for all but special commercial packaging was discontinued about 1936, and collapsible plastic tubes and containers were substituted for metal containers wherever practicable. Distillery pipes as well as containers have been made of glass as much as possible. To build up reserve supplies, used tubes and containers have been collected and metals recovered from municipal wastes, while some quantities were taken from stocks in occupied territory.

Another field where tin is saved is in making soft solders, which formerly contained as much as 40 per cent. tin. Some new solders, according to *Chemische Fabrik*, using either pure lead with an unusually sharp flux, or an alloy of lead with 6 to 8 per cent. of cadmium, or with small amounts of zinc, copper, or tin, are claimed to be as good as old-style solders. Care must be exercised, however, in the use of solder fat when soldering copper, brass, zinc, and lead, and reports indicate that solders of less than 25 per cent. tin have not been successful for electrotechnical soldering. In this connection it is of interest that in Italy a process is claimed to have been developed whereby an alloy of tin, lead, and cadmium can be welded with aluminium.

Antimony, another valuable metal, particularly for bearing and type metals, was formerly obtained mostly from China. Chinese production has dropped since 1935, but Germany has met her deficiencies partly from Slovakia and Austria, and more recently from Yugoslavia. Yugoslavia's production of antimony ore rose from 8000 metric tons in 1937 to a record of 24,000 tons in 1940, to make her the largest continental producer. The Reich has now obtained control of Montania A. G., the leading Yugoslav producer. Hungary also accounts for some antimony production, but has to export its ore for smelting like Austria, which used to send its ores to Belgium. The Thüringsche Rohstoff A. G., Weimar, Germany, obtained control of Austrian mines in 1938. Antimony is not now used in Germany for manufacturing munitions, but chiefly in automobile batteries, in compounds in the dye industry, and in the rubber industry.

China and Burma have also ceased to supply tungsten for light filaments and as an alloy for high speed machine tools and magnets. Whether Japan will be able to make supplies of such materials available to the Reich, from the territory she has recently occupied, is questionable.

A Practical Corrosion Tester*

Time-Saving Device for Metallurgists and Others

IN the numerous industrial research investigations involving corrosion problems at the Armour Research Foundation it has been made clear that any such study must take into account the true conditions under which the corrosion may occur in the field. Corrosion investigations nearly always involve laboratory tests, and it is feared that more often than not the tests fail to yield a true index of material performance. Because corrosion is not a simple phenomenon, any simple general test of it should be looked upon with extreme suspicion.

The literature on corrosion is extensive, both in theory and practical application; however, the engineer attempting to determine just what will happen to a given piece of equipment or installation under certain conditions, finds himself confronted with the considerable task of deciding which available data, if any, are applicable to his problem. In case none can be found, there remains as the only alternative a corrosion test, preferably an accelerated one. Here again, the engineer must decide which test is best suited to give him the answer to his problem.

Let us for a moment consider a specific case. An engineer is commissioned to design and construct an outdoor installation handling a corrosive liquid in pipes and spraying the liquid in such a way that contact between the liquid and portions of the structure is unavoidable. Naturally the engineer anticipates corrosion troubles, and promptly begins a search for corrective measures. He may subject his structural material to a standard salt spray test, but since there may not be salt-water-carrying air within a thousand miles of the structure he is to build, it will not tell him what he wants to know. Again, he may utilise an accelerated oxidation test, but this will completely ignore galvanic action produced by contact of dissimilar metals in the presence of an electrolyte. In short, while he is able to apply certain tests more or less simulating some of the conditions under which his installation is to be operated, upon completion of such tests he still lacks the information he wants, and that is: What, in this particular case, will be the result of the collective action of: heat (both in pipes and outside); galvanic corrosion; concentration cell corrosion; intermittent wetting (rain); oxidation (atmospheric); and corrosive effects of the liquid.

Factors in Corrosion Reactions

Most engineers are well acquainted with the picture of the guests sitting at the corrosion banquet, each one taking his particular share of metal. Those who may have forgotten for the moment need only to recall a few fundamental rules, given below, for our present purpose.

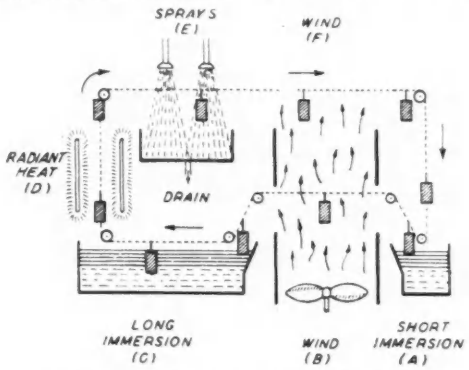
1. Temperature. (a) Corrosion reactions are accelerated with increased temperature, as are chemical reactions in general. (b) An increase in temperature can result in increased ionisation and rates of diffusion. (c) Local differences in temperature may set up electrolytic cells acting as concentration cells.

2. Moisture. Serious damage by corrosion to metal parts commonly takes place only if the metal surface is moist.

3. Galvanic action. (a) When two dissimilar metals are coupled and placed in an electrolyte, corrosion takes place. (b) When a metal is placed in a solution in which the solute is stratified in different concentrations, corrosion of the metal takes place.

A consideration of the above factors illustrates not only the complexity of corrosion causes, but also the futility of a practical prediction of what will happen to equipment under given conditions, unless similar conditions can be produced in the course of a test. In order to accomplish this, in a great variety of applications the apparatus shown diagrammatically herewith is often used in the Armour Research Foundation laboratories. The endless chain indicated by the dotted line is equipped with hooks from which test specimens are suspended, and when moving in a clockwise direction, 85 minutes are required for a specimen to reach its original starting point.

The flexibility of such an apparatus is apparent. Water or the particular type of liquid which the problem involves, is placed into the immersion tanks A and C. The radiant



Action-diagram of the corrosion tester

heat chamber D may be operated at different temperatures, or not at all. At point E the sprays may be used with water or the liquid in question, or not at all. In addition, the fan at point B may be operated to subject the specimens at points B and F to a continuous fresh supply of air (oxygen).

There are, of course, many problems in which this apparatus is inadequate. Its variability, however, answers a large portion of the ordinary laboratory demands, and its agreement with actual field results is most gratifying. While the unit was designed primarily to determine the collective effect of corrosive conditions upon metals, it has also been used advantageously in weathering tests on non-metals, such as paint, plastics, etc. In the case of paints, the radiant heat chamber D should be equipped with a source of ultraviolet light.

In much of the current work at the Research Foundation, test specimens of steel, cast iron, brass, copper, and aluminium are used. The specimen strips, approximately ½ in. by 3 in., used both individually and coupled dissimilarly, are suspended from the endless chain by means of glass hooks. Preparation of the specimens consists of careful cleaning with emery paper, followed by washing in alcohol and ether and weighing. The duration of a test is generally two weeks' continuous operation. On completion of the test the specimens are rinsed in distilled water, alcohol, and ether, and reweighed.

Treatment of Specific Problems

Let us now return to the specific corrosion problems raised earlier. Assuming the liquid to be a 30 per cent. calcium chloride brine, naturally the immersion tanks are filled with brine. Since the brine is to be sprayed at 50° C., the radiant heat chamber D is maintained at a temperature of 50° C. Being erected out-of-doors the structure is exposed to intermittent wetting by rain, and in part by continuous spraying of the brine; hence the sprays should be operated with water. The action of wind must be considered, consequently the fan at point B must be operated. Since the structure is held together by welds, rivets, and bolts, dissimilar metal couples should be used for the specimens in addition to the individual metal strips. Cast iron, steel, and aluminium are the metals which probably will be employed for construction. In a case of this kind,

* From an article by Martin H. Heeren, chairman of the Chemical Engineering section, Armour Research Foundation, Chicago. (*Chem. Met. Eng.*, 1942, 49, 2, p. 126).

after operating the apparatus under the above conditions for two weeks, the results shown below were obtained.

Metal		Corrosion mg. wt. change	Corrosion mg. per sq. in.
Single strips	steel	13.90	4.48
	aluminium	18.90	4.80
	cast iron	50.20	11.45
Coupled	steel	27.5	8.87
	aluminium	230.0	63.40
Coupled	cast iron	29.1	6.00
	aluminium	228.0	63.30
Coupled	steel	56.0	18.05
	cast iron	15.8	3.27

The above values express the actual weight-change in each test strip, but they do not show the actual depth of corrosion. To obtain the latter it is necessary to divide the weight-change in each case by the specific gravity of the corresponding metal. In the following table are given the values for the depth of corrosion thus calculated.

Metal		Relative Thickness Corroded
Single strips	steel	.57
	aluminium	1.78
	cast iron	1.58
Coupled	steel	1.13
	aluminium	23.50
Coupled	cast iron	.83
	aluminium	23.40
Coupled	steel	2.31
	cast iron	.45

Examination of the data above tells us at once that aluminium is not the metal to be used in our hypothetical structure. The quotient $\frac{23.50}{1.13} = 21.7$ signifies that a sheet of aluminium will be destroyed 21.7 times as fast as the same thickness of steel. It further tells us that cast iron should be used as extensively as possible, with steel serving as second choice.

The above illustration serves to indicate the possibilities of the apparatus. Simple in construction, it permits the establishment of certain known field conditions in the laboratory, thus aiding the engineer in his choice of materials and prediction of corrosion rates.

New Armour Plate

Advantages in Aircraft Construction

THE outstanding characteristic of "Colalloy" armour plate, as reported recently in the *Journal of the Franklin Institute*, is that it weighs about 50 per cent. less than steel, and is thus particularly applicable to aircraft construction. The surface of the plate is claimed to have a hardness much greater than that of ordinary armour plate. It is available in any thickness up to 3 inches, with the hard surface extending to any depth from 0.001 inch to $\frac{1}{4}$ inch. One of the major factors influencing projectile penetration is the heat generated by friction when the projectile passes through the armour plate. Colalloy armour plate is claimed to have a rate of heat dispersion which is several times greater than that of steel armour plate, thus tending materially to lessen the penetration of projectiles. Another advantage of this material is its hard, highly-polished surface, which does not deteriorate, thanks to its resistance to corrosion and oxidation. This glassy smoothness tends to make a bullet glance or slide off, thus preventing it from "biting" into the metal. The new plate is also claimed to have a marked resistance to ice formation. In using Colalloy, production bottlenecks can be avoided, it is stated, since each aircraft factory can have its own processing plant, and heat-treating operations and expensive equipment are unnecessary. This material is intended for use in the construction of propellers, wings, fuselages, exposed engine parts, pontoons, struts, tanks, etc. It can be supplied in many forms to suit individual production requirements.

The Tin Position

Current Supplies and Recent Research

AN article on Tin and the War in the Pacific, included in *Tin and Its Uses* No. 12, which has been published by the Tin Research Institute, states that the present annual supply of tin is about 78,000 tons against a pre-war consumption of 110,000 tons. War requirements and buying for private stocks have brought the total demand recently up to a rate equal to 175,000 tons per annum. These figures make it clear that restriction of consumption must be applied swiftly, but skilfully enough to avoid dislocation to industry. All stocks must be utilised with the utmost discretion, and the less necessary uses must be suspended in favour of those indispensable to the war effort.

The second interim report on research for improved solder fluxes is also published in this issue. It gives the compositions of a number of useful non-corrosive fluxes which have given satisfaction in laboratory tests. Improvements in the smoothness of tin coatings on tinplate have been effected by the use of an experimental tinning machine designed at the Institute. The machine incorporates special features which eliminate the longitudinal and transverse ridges characteristic of coatings on commercial tinplates. The protective film for tinplate developed at the Institute has undergone further trials in South America and Australia, and has been included in the Foodstuffs Specifications of the Department of Supply and Development in Australia.

Other articles in the current issue of *Tin and Its Uses* describe an interesting and novel use of tinplate in iron foundries; a recent official statement on the safety of canned foods; and the method of controlling the anodes in the sodium stannate plating bath so that the deposits shall be smooth and tightly adherent.

Powdered Chromium Metal

Results of U.S. Research

A FORM of sponge, or powdered, chromium metal that under certain conditions attains a purity of 99.8 per cent.—higher than any chromium used in present commercial manufacturing—has been produced from both low and high grade domestic chromite ores through a process developed by metallurgists of the U.S. Bureau of Mines, according to Dr. R. R. Sayers, Director of the Bureau.

The high purity and powdered form of this new metal render it valuable in the manufacture of special steels, brass and bronze materials, and in alloys that are subjected to high temperatures, such as electrical heating elements.

Successfully carried through the laboratory stage to a point where pilot plant tests are justifiable, the new reduction process may under favourable circumstances permit the utilisation of a large amount of America's "off-grade" chromite ores at costs comparable to the existing prices of low-carbon ferrochrome, though this will depend chiefly upon the availability and cost of chlorine, the chemical used extensively in producing this new metallurgical material.

Low-temperature reduction without sintering is the basis of the process developed by the Bureau of Mines during five years of research and investigation in obtaining pure chromium metal. The fundamentals consist of the chlorination of chromite ores at elevated temperature, sublimation and separation of volatile chlorides, and reduction of chromium to metal by hydrogen. Sponge chromium of at least 99 per cent. purity may be produced, and if specially purified chloride is used, the product may reach 99.8 purity. Methods and formulae employed in the laboratory production of sponge chromium by the chlorine method are described in detail in "Sponge Chromium" by C. G. Maier, the technical bulletin No. 436 soon to be published by the Bureau of Mines, obtainable from the Superintendent of Documents, Government Printing Offices, Washington, D.C.

General News——From Week to Week

Telegrams to and from Great Britain and Northern Ireland or Eire must, until further notice, be written in plain English. No telegrams in code will be accepted for transmission.

Another national waste-paper contest is being held from May 1 to July 31 for awards of £10,000. The money will be awarded for heaviest weights of waste paper, books, cartons, and the like per thousand of the population.

Methanol poisoning caused the death of ten persons in Glasgow last week, and the serious illness of several others. The victims were a party of dockers and their friends, who drank the liquid emerging from leaking drums of industrial spirit in store at the docks.

Direction No. 2 (S.R. and O. 1942, No. 704) under the Control of Tins, Cans, Kegs, Drums and Packing Pails (Nos. 5 and 6) Orders, 1942, frees crown corks for milk bottles from the restrictions imposed by the No. 6 Order on the use of tinplate for crown corks generally.

Nearly 1000 names of persons and firms in neutral countries, with whom trading of any kind is illegal, are contained in the Trading with the Enemy (Specified Persons) (Amendment) (No. 6) Order, 1942 (S.R. and O. 1942, No. 661; price 6d.). Deletions number only 57.

Foreign scientists resident in Britain, who are faced with difficult problems in connection with work they are desirous of carrying out to help the national war effort, should write to the Secretary, Foreign Scientists Committee, Association of Scientific Workers, 73 High Holborn, W.C.1, for assistance in such matter.

We have often remarked on the humorous quality of "600," the house magazine of George Cohen and Sons, and associated companies. This is fully maintained in the recent issue just received, but no less interesting is the account of the work that has been done, in the national interest, towards the examination and distribution of machine-tools and the reconditioning of machinery. This work is being continued at high pressure and with notable success.

Publication No. 36, of the Copper Development Association, entitled "Classification of Copper and Copper Alloys," shows at a glance the more important properties and applications of the principal types of copper and copper alloys, and should prove of value at present when alternative materials for particular purposes have to be selected. The references to the appropriate British Standards should also be helpful. A limited number of copies of the booklet are available to our readers on request.

The question of the supply of protective clothing to chemical workers, the inadequacy of which was noted on this page in our last issue, has now been taken up by the Chemical Workers' Union. The Union Executive is representing to the Board of Trade that at any rate not less than 25 coupons per operative should be issued, but that the best method of dealing with the situation is to issue to firms, subject to a factory inspector's certificate, priority supply warrants for the requisite clothing.

Speaking at St. Austell last week on the vital problem of man-power, Mr. A. Davies expressed the view that unless consideration were given there was a possibility that the china clay trade might go the same way as other industries in Cornwall. Mr. W. H. J. Priest, chairman of the Plymouth Man-Power Board, replied that china clay was not a primarily important product during the war, and he was not in a position to say that the industry would not be touched any more. He suggested that the companies should get down to a concrete proposal, whereby they could say that concentration of the industry was an accomplished fact. All efforts should be focussed on getting the war over.

Foreign News

Aluminium-Industrie A.G., of Chippis and Neuhausen, the important Swiss company, reports that magnesium from indigenous raw materials is being made in a new plant and that a plant for the manufacture of artificial cryolite is being built. It is further stated that bauxite production at the company's plants in Italy and Croatia was obstructed by transport difficulties, while that in France increased. The alumina plants at Bergheim and Porto Marghera had been working at full capacity and were extended, but the Marseilles plant suffered from raw material shortage.

A detergent made from raw materials obtained by chemical treatment of petroleum, and known as "MS-Soap," is now supplied to German laundries as part of their soap ration, together with soap powder and flakes and synthetic washing agents.

The Mawchi mines in Burma, 20 miles east of Toungoo, which produce two-thirds of the total wolfram output of the British Empire, and which have been captured by the Japanese, had been previously rendered useless to the enemy by experts, having been put out of action for at least 18 months, according to a Reuter report.

Output of bauxite in the United States in 1941 totalled 899,500 long tons, according to the preliminary estimate of the Bureau of Mines, compared with only 438,913 tons in 1940. Imports of bauxite during the first nine months of 1941 totalled 749,264 tons, a tonnage considerably greater than ever received during any previous full 12-months' period. Domestic production and importations in 1942 are expected to surpass those even of 1941 by a large amount. Consumption of bauxite also broke all records in 1941, and is estimated to have aggregated about 1,700,000 tons, compared with 1,072,000 tons in 1940. It is estimated that the aluminium industry consumed about 70 per cent. of this bauxite and the chemical, abrasive, and other industries about 16, 12, and 2 per cent., respectively.

British Chemical Prices

Market Reports

TRADE in most sections of the general chemicals market is proceeding along steady lines with deliveries covering good volumes. So far as fresh business is concerned, there has been a moderate flow of inquiry, but actual bookings have been somewhat restricted by the supply position. There is no change in the soda products section, where most items continue firm. In regard to the potash chemicals, supplies of yellow prussiate of potash remain scarce, whilst a good demand is reported for permanganate of potash, with quantities of carbonate of potash and caustic potash readily taken up by approved buyers. Amongst the acids a steady demand is maintained for acetic and oxalic with supplies of the latter item scarce. Hydrochloric acid is also in good request at the recently advanced quotations. Elsewhere formaldehyde is active and British makers' quotations for barium chloride firmer. The chief interest in the coal-tar products market is the publication of the Control of Coal Tar Order which provides for a system of registration and licensing for such coal-tar acids and coal-tar products as may be directed by the Secretary for Mines. The Coal Tar Acids Prices (Inland) Order fixes maximum prices for cresylic acid which, however, may be increased by an amount not exceeding 3 per cent. for material handled by dealers.

MANCHESTER.—Taking the Manchester chemical market as a whole, a moderate volume of new business has been reported during the past week, and although in one or two directions the demand for contract deliveries is below the normal aggregate volume the home and export demand combined are sufficient to absorb supplies in the majority of instances. In some cases offers for near delivery positions are decidedly on the short side, especially bichromates, permanganate, barium chloride, certain acid products, and, of course, the general run of potash compounds. Most of the tar products are active and on a firm price basis.

GLASGOW.—Business in the Scottish heavy chemical trade during the past week continued to remain rather quiet, both for home and export. Prices still keep very firm at a high level.

Price Changes

Barium Chloride.—98/100%, prime white crystals, £16 5s. per ton, bag packing, ex works; imported material dearer.

Cresylic Acid.—Pale, 97%, 3s. 6d. per gal.; 99%, 4s. 2d.; 99.5/100%, 4s. 4d. per gal. Controlled prices.

Hydrochloric Acid.—Spot, 6s. 5½d. to 8s. 11d. per carboy, d/d, according to purity, strength, and locality.

Naphthalene.—Crude, in 4-ton lots, in sellers' bags, £6 6s. 8d. to £9 7s. 7d. per ton, according to m.p. In sellers' bags, 2-ton lots; hot-pressed, £11 3s. to £11 8s. per ton; purified crystals, £19 to £35 per ton. Controlled prices.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

CHEMO-METALS (LONDON), LTD. (M., 2/5/42.) April 1, £600 debenture to Colibri Lighters, Ltd.; general charge.

Satisfaction

BRITISH CERAMICS AND CRYSTAL, LTD., Brierley Hill. (M.S., 2/5/42.) Satisfaction, April 8, £200, registered December 1, 1941.

Company News

Lewis Berger and Sons, Ltd., have declared an interim dividend of 6 per cent., thus restoring the normal dividend rate.

British Benzol and Coal Distillation, Ltd., have declared an interim dividend of 5 per cent. (same).

The British Silk Dyeing Co., Ltd., announce a net profit for 1941 of £15,589 (£12,412 net loss).

British Lead Mills, Ltd., report a profit to October 31 of £8372 (£12,598).

United Molasses, Ltd., report a net profit for 1941 of £373,355 (£566,314), and have declared a final dividend of 12½ per cent., again making 20 per cent. for the year.

The British Match Corporation, Ltd., report net profit of £340,881 (£391,566), and, in addition to the usual half-yearly payment on the 5½ per cent. preference stock, the directors recommend a final dividend on the ordinary of 5¼ per cent., less tax, making 8 per cent. for the year (same).

Chemical and Allied Stocks and Shares

STEADY conditions have ruled in most departments of the Stock Exchange, the absence of selling having continued to influence sentiment more than the very small volume of business again in evidence. The day-to-day trends of markets were governed mainly by that in British Government stocks. Nevertheless, owing to the continued disposition to await the next war developments, quotations for many of the less widely-held industrial securities were not adequately tested by dealings this week.

Imperial Chemical were again one of the more active securities, and as compared with a week ago, have improved from 32s. 10½d. to 33s. 1½d. at the time of writing. The tendency is to await the full results and annual statement for fuller information as to the position and any indication of views as to the outlook for the current year. I.C.I. 7 per cent. preference units have been steady at 35s. 7½d. Lever and Unilever were around 25s. awaiting the forthcoming results of important subsidiary concerns, but elsewhere, Borax Consolidated were easier, having moved back slightly to 30s. 6d. United Molasses at 28s. 9d. were also rather lower than a week ago, sentiment having been affected by the reduced profits shown by the preliminary results, although the total distribution is again being brought up to 22½ per cent. including a bonus of 2½ per cent., tax free. Dunlop Rubber were 24s. 9d., a lower payment for 1941 being generally expected in this case. On the other hand, the units of the Distillers Co. had a relatively firm appearance at 74s. 9d., the market having remained hopeful that the dividend may be maintained at 16¼ per cent. Fison Packard were again 38s. 9d.; the interim dividend is due in a few weeks. Elsewhere, Boots Drug were 32s. 6d. and British Drug Houses around 26s. while W. J. Bush shares, which are firmly held and do not often change hands, showed business at 39s. 6d. at one time.

Awaiting the financial results, Amalgamated Metal shares were easier at 15s., but Babcock and Wilcox have been maintained at 44s. 3d. at the time of writing. Cellon were around 16s. and Goodlass Wall 10s. ordinary were again 8s. 9d. pending the dividend announcements. B. Laporte, whose annual results are also impending, remained at 63s. 9d. Monsanto Chemicals 5½ per cent. preference were again 22s. 6d. Cooper McDougall 23s. 9d., and Greeff Chemicals 5s. units were quoted at 5s. 7½d. In other directions, business at 7s. was shown in William Blythe 3s. shares and at 15s. 6d. in British Thermostat 5s. ordinary. There was again a good measure of activity in shares of companies connected with plastics. Under the influence of the chairman's annual statement, Lacrinoid Products 2s. ordinary have transferred up to 2s. 10½d., while Erinoid 5s. ordinary again changed hands around 7s. 6d. Catalin and De La Rue shares also recorded a number of dealings.

Only small movements were again shown in iron, steel, and allied securities. Stewarts and Lloyds were around 47s. awaiting the full results for the past year's working. Tube Investments were 82s. 3d. and United Steel were 23s. 1½d. In advance of the dividend announcement, Canning Town Glass 5s. shares transferred at slightly over their par value. Triplex Glass were 29s. 1½d. and business at 55s. was recorded in United Glass Bottle. Wall Paper deferred units were slightly better at 22s. 9d. and Barry and Staines were 27s. 6d., awaiting the financial results. Nairn and Greenwich were 53s. 9d. Steadiness at 8s. 7½d. was shown in General Refractories, following the remarks at the annual meeting. There were few changes among textile issues; Courtaulds were 33s. while small gains were made in Fine Spinners and Calico Printers. Only small movements were shown in oil shares.

Forthcoming Events

The annual general meeting of the London Section of the **Society of Chemical Industry** will be held in the Rooms of the Chemical Society, Burlington House, W.1, at 2.15 p.m., on **May 4.** A paper, presented by H. K. Whalley, B.A., Ph.D., and J. G. N. Gaskin, B.Sc., F.I.C., on "Polarographic Methods of Analysis," will follow.

The Midlands Centre of the **Electrodepositors' Technical Society** will meet on **May 5,** at 6 p.m., at the James Watt Memorial Institute, Great Charles Street, Birmingham, when Mr. E. A. Ollard will deliver a talk on "Heavy Chrome Deposition." It should be noted that the subject matter of this talk will not be published.

The Society of Public Analysts will meet at 5 p.m., on **May 6,** at the Chemical Society's Rooms, Burlington House, W.1, when the following papers will be presented and discussed: "The Analysis of Foods containing Meat, Cereal Filler and Soya Bean Meal," by E. T. Illing, B.Sc., F.I.C., and E. G. Whittle, B.Sc., F.I.C.; "The Gravimetric Micro-determination of Magnesium," by P. F. Holt, Ph.D., F.I.C.; "The Iodine Value as an Index of the Relative Firmness of Pig Back Depot Fat," by W. Bolton, M.Sc., and R. G. Baskett, M.Sc., A.I.C.

The Newcastle-upon-Tyne and North-East Coast Section of the **Institute of Chemistry** will meet at the Black Lion Hotel, High Street, Stockton-on-Tees, at 7.15 p.m., on **May 7,** when Professor F. A. Paneth will deliver a lecture on "The Completion of the Periodic System."

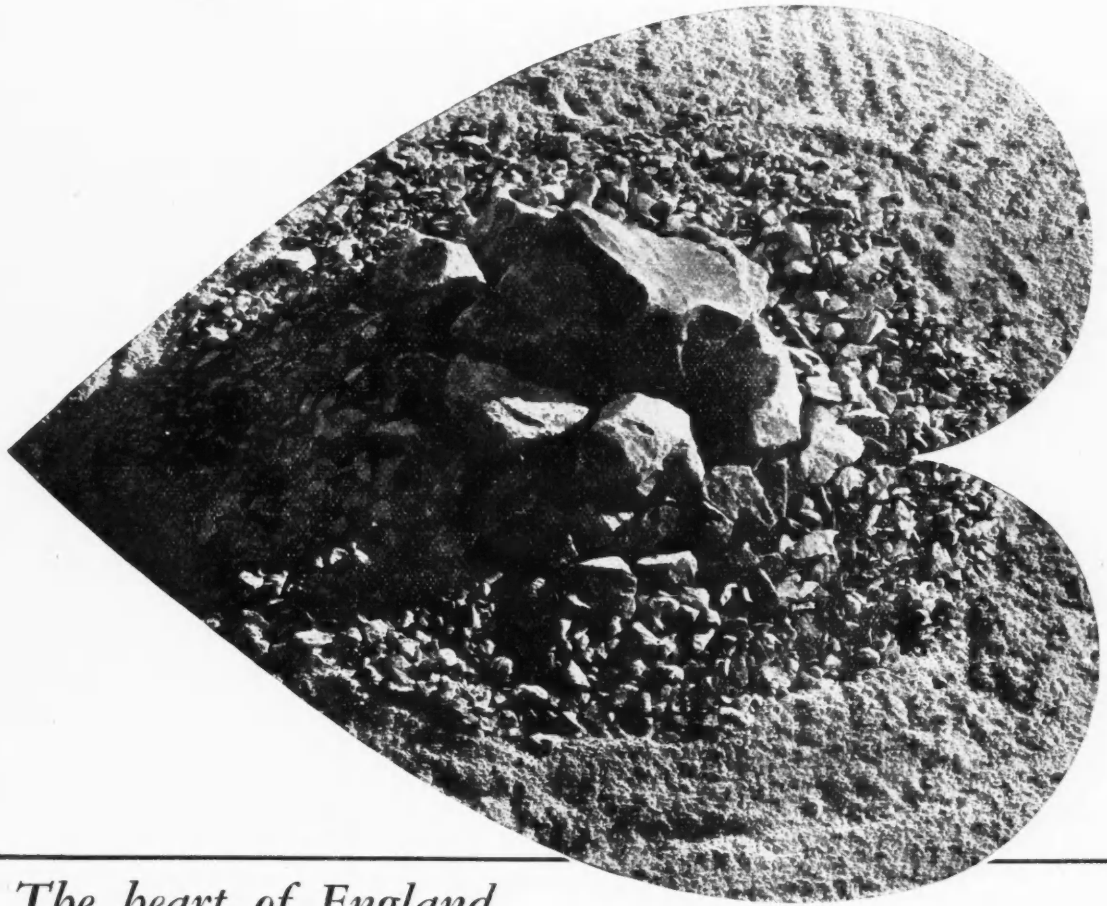
Professor T. P. Hilditch, F.R.S., will deliver a lecture on "The Approximate Computation of the Mixed Glycerides in Natural Fats," following the annual general meeting of the Liverpool Section of the **Society of Chemical Industry,** which will take place in the Muspratt Lecture Theatre of the University, Liverpool, at 6.30 p.m., on **May 8.**

"Recent Developments in Metal Rectifiers as Applied to Electro-Deposition" is the title of a paper to be presented by Mr. D. Ashby, at a meeting of the London Section of the **Electrodepositors' Technical Society,** to be held at the Northampton Polytechnic, E.C.1, at 5.30 p.m., on **May 11.**

The Leeds Area Section of the **Chemical Society** will meet in the Chemistry Department of the University, at 7 p.m., on **May 12,** when Dr. W. H. Mills will deliver the eighth Pedler Lecture, entitled "Recent Progress in Stereochemistry."

"Chemical Engineering in the Laundry Industry" is the title of the paper to be presented by Mr. F. Courtney Harwood at the meeting of the **Institution of Chemical Engineers,** to be held in the Rooms of the Geological Society, Burlington House, W.1, at 2.30 p.m., on **May 12.**

The Plastics Group of the **Society of Chemical Industry** is holding a luncheon at Stewart's Restaurant, at 12.45 p.m. for 1 p.m., on **May 12,** to be followed by the annual general meeting of the Group at 2-2.30 p.m. After this, in the Rooms of the Chemical Society at Burlington House, W.1, there will be a meeting of the Group, when Mr. H. Courtney Bryson will speak on "Some Aspects of the Gramophone Record."



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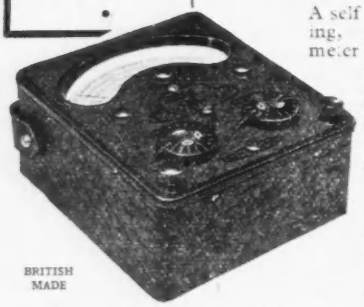

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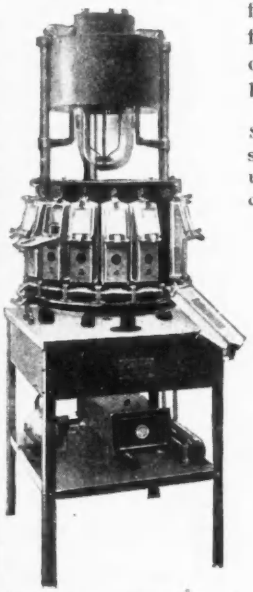

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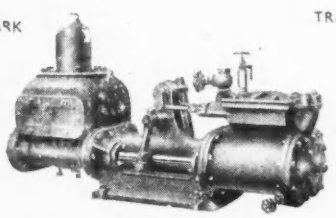

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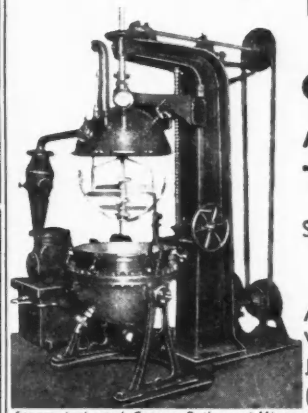

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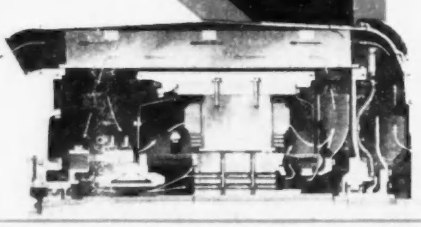

METROPOLITAN Vickers ELECTRICAL CO. LTD. TRAFFORD PARK MANCHESTER 17.

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